WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Evaluation and Analysis Rolling Resistance and Wear Resistance

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ABSTRACT

The tyre is one of the most ancient parts of any vehicle used to convey goods. The natural or synthetic rubber compound employed for the tread is the most important component. The tyre is one of the most important components of a vehicle. A purpose of this research study is to look into the HD-HS. The number of different varieties of silica for use in tyre, according to studies Although silica is used in Tyres to improve performance, This work made use of advanced silica, also known as highly purified silica. Silica that is dispersible and has a high surface area (HD-HS).The tyre's properties is also affected by this advanced material. Wet grip, wear resistance, and friction coefficient are examples of materials. The primary emphasis is on rolling resistance and wear. The tyre's resistance; it has a considerable impact on fuel consumption. When driving at a constant speed, you can save money.

Key words: Tyre Materials, Rolling Resistance, HD-HS Silica, Wear Resistance

I. Introduction

Since John Boyd Dunlop invented tyres in the 1880s, performance improvement has always been a consideration. The most recent major tyre research development has been focused on reducing vehicle fuel consumption and increasing tyre mileage. The suspension system, brakes, and tyres must all absorb some of the kinetic energy created by a conveyance [1].

The aspect ratio of a tyre is decreasing presently, which is the height of the sidewalls divided by the width of the tyre. This trend is being driven by increased transportation power and the growing relevance of design. It also provides improved handling on dry roads. Tread pattern types' prominence in the consumer market is mirrored in tyre design. The tread design was relatively simple at the exordium of the pneumatic tyre. Tread patterns with intricate patterns are quite popular. Summer, winter, and all-season tyres are the most prevalent types of tyres. These tyres not only feature varied tread patterns but also different rubber compounds. Even at low temperatures, winter tires have a softer tread rubber complex than summer tires.

The tyre's major goals are to: I carry the mass, (ii) give acceleration and braking services to the tyre on the road, and (iii) provide luxury and dampen unpleasant shakings.

Different requisites are derived from these tyre properties and are deemed supreme for tyre quality evaluation [2].

The main objectives of the tyre are:

(i) To carry the mass

(ii) To conduct acceleration & braking services to tyre on the road

(iii) To provide luxury and weaken unwanted shakings.

These tyre characteristics result in different requisites which are considered supreme for the evaluation of tyre quality [2].

A. Tyre Functions The Functions of Tyres Vehicle-to-Road Interfacing Vehicle Load Support Friction on the Road Surface Irregularities on the road should be absorbed

B. Tyre Compositionblack carbon HD Silica (Highly Dispersible) Silica HD-HS (Highly Dispersible and Highly Surface) Silica

C. Wear Resistance Resistance to Wear Contact between tribo-pairs causes junction breaking, according to Archard's wear theory. The roughness surface, on the other hand, is the only place where contact happens [5].

D. Resistance to Rolling

Many individuals are interested in fuel conservation and the national aim of more energy efficient vehicles, and the issue of tyre rolling resistance has sparked their attention. Tyres are widely recognised as one of the most significant loss mechanisms for a vehicle's engine power. The impact of tyre rolling resistance on driving cycle fuel consumption in quantitative terms

II.Materials and methodology

A form of tyre filler is HD Silica. To improve rolling resistance, silica is added to tyre composition. Because the presence of carbon black in tyre material increases rolling resistance, adding HD silica to the material lowers it. Standard HD silica in passenger car tyres agglomerates, restricting reinforcing qualities and rendering it incompatible with emulsion-based polymers like natural rubber. HD-HS silica is another filler material. It is a new generation of cutting-edge tyre filler material. This material has improved dispersion and may be used for more demanding profile requirements, resulting in improved wear resistance without sacrificing rolling resistance or wet grip.

Table 1: Classification of silica used for making Tyre

Silica Type	**Area of Surface (m2/g)**		
	89-130	**128-180**	**178-220**
Conventional	Type casings	Tyre casings	Tyre treads
Highly Dispersible high surface area	_____	_____	High- performance
Semi-highdispersion	Typecasings	Tyrecasings	Tyre treads
Dispersion	Type casings	Tyre treads	_____

Table 2: Characteristic Properties of Material

Physical Property	**Unit**	**Conventional Silica**	**HD silica**	**HD-HS silica**
CTABsurface area	m^2/g	112	161	201
BET surface area	m^2/g	118	166	214
Diameterof elementary particles	m^2/g	26	22	10-12
Mean Diameterof aggregates	m^2/g	96	62	56-62

The rolling resistance expressed as a resistance force opposing forward motion, the value of which is given by the product of the rolling resistance coefficient fw and vertical load.

$$Fw=fwN=(d/R)\ xN$$

Where

Fw = Coefficient of Rolling Resistance

fw = Rolling Resistance

N = Force

Kevin Cooper proposed the following empirical formula for calculating losses due to tyre rolling resistance. Theformula considers inflation pressure as well as forward velocity:

For velocities below 165 km/h

Table 3: rolling resistance on Different velocity of tyre

S.No	Pressure in bar	Velocities of Tyrein km/h	Coefficient of Rolling Resistance
1	1.2bar	52	0.03033
2	1.6bar	72	0.02469
3	2.2bar	92	0.031439
4	2.8bar	112	0.02319
5	3.4bar	132	0.02445
6	3.9bar	152	0.02346
7	4.2bar	164	0.02482

Abrasion resistance According to Archard's wear theory, contact between tribo-pairs produces junction failure. Contact, on the other hand, happens solely at the roughness surface. In the picture, the cross section of the rough surface following plastic deformation is assumed to be round, according to the Archard model.

$$Q = KWL/3H$$

Where

Q = Volume of Wear Material

K = Probability of wear

W = Load

L = Sliding Distance of Tyre

Table 5: Wear resistance Calculation

S. No	Probability of Wear (K)	Load in kN (W)	Hardness of material GPa (H)	Volume of Wear Material (Q)
1	1.11×10^{-04}	10	2	1.85×10^{-4}
2	1.11×10^{-04}	14	2	2.59×10^{-4}
3	1.11×10^{-04}	18	2	3.33×10^{-4}
4	1.11×10^{-04}	22	2	4.07×10^{-4}
5	1.11×10^{-04}	24	2	4.44×10^{-4}

III. RESULT

When mixed with other materials, carbon black improves the tyre's wear and tear characteristics. Silicon is added to the tyre mix to increase rolling resistance. Because black carbon in tyre material increases rolling resistance, adding HD silica to the tyre mix lowers it. This appropriate high-speed and heavy-load vehicle obtains remarkable dispersion after employing HD-HS silica. As the silica concentration rises and the carbon black portion decreases, the hardness decreases. To reach the same level of hardness as carbon black, a higher amount of silica is necessary.

IV .CONCLUSION

It was discovered that using HD-SH silica in wheels can result in longer tyre life, higher dispersion, and lower rolling resistance after evaluating various materials in tyres. With velocity and tyre pressure, the friction coefficient force changes. Wear resistance is affected by normal force and tyre pressure.

REFFERENCE

[1] Michelin, The tyre, Grip, Technologies Michelin, 2001.

[2] Santoshi Mihara Reactive Processing of Silica-Reinforced Tire Rubber New Insight into The Time-And Temperature-Dependence of Silica Rubber Interaction 2009.

[3] OECD, Nano-Technology and Tyres Greening industry Report, ISBN 2014.

[4] S.K. Clerk and R.N. Dodge, Rolling Resistance for pneumatic tyre book, 1979.

[5] Harish Fundamental of Engineering Tribology Book ISBN, 2016.

[6] Heinz Advance Vehicle Technology Book, ISBN 2002.